

I MADE A CELL PHONE!

(Don't tell the FCC kthx)

Kevin Lynagh
!!con 2015

Motofone F3



Smartphones



Dumbphones



Solution:

Build my own
awesome phone







Building a phone:

1. Electronic stuff
2. Software stuff
3. Ind. Design stuff

Electronic
stuff

You have 20 minutes to complete this closed-book lab-ticket. 11:10 - 11:20.

1. Determine an expression for the gain $G = \frac{V_{out}}{V_{in}}$ of the non-inverting amplifier shown in Fig. 1. The triangles indicate the ground (0 V) level, relative to which V_{in} and V_{out} are measured.

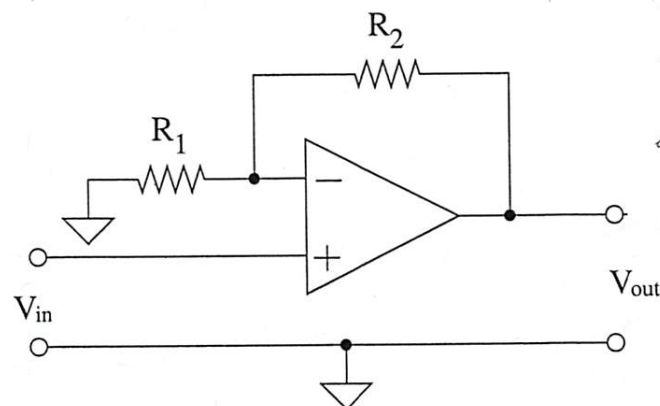


Figure 1: Non-inverting amplifier

Assume $V_- = V_+ \Rightarrow V_- = V_{in}$
& no current flow through opamp \Rightarrow all
flow through R_1 & R_2 , which form a voltage
divider:

$$V_{in} = \frac{R_1}{R_1 + R_2} V_{out} \quad \times$$

$$G = \frac{V_{out}}{V_{in}} = \frac{R_1 + R_2}{R_1} \quad \times$$

2. Derive an expression for the input impedance, $Z_{in} = V_{in}/I_{in}$, for the circuit shown in Fig. 2. (Hint: Use the Golden Rules for operational amplifiers and Kirchoff's laws.)

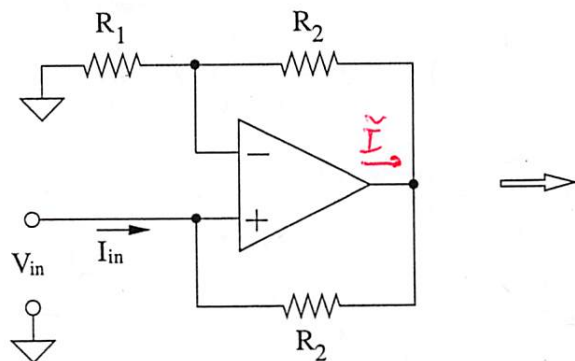


Figure 2: What is the input impedance?

Since no current flows
through the op amp, it
all must flow through $R_2 + R_1 + R_1$
before reaching ground.

$V_- = V_{in}$, so the current
that flows through $R_2 + R_1$ is given
by

$$\Delta V = (R_2 + R_1) I$$

$$= 0$$

which gives an input impedance

$$Z = \frac{\Delta V}{I} = \infty \quad (\text{AKA very high, which} \\ (\text{I'm told}) \text{ is why op amps} \\ \text{are so useful})$$

Op amps source
current!!

g-

You have 20 minutes to complete this closed-book lab-ticket. 11:10 - 11:20.

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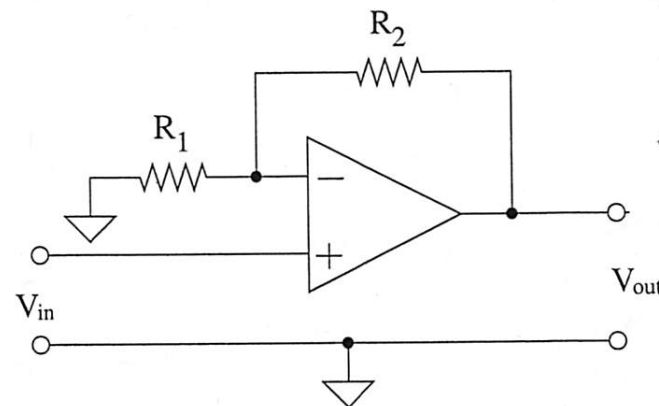


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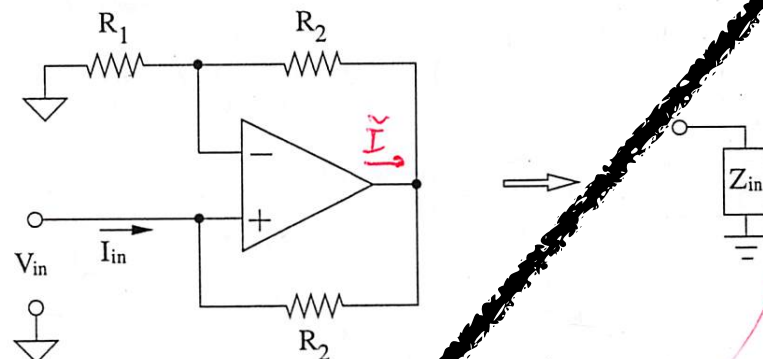


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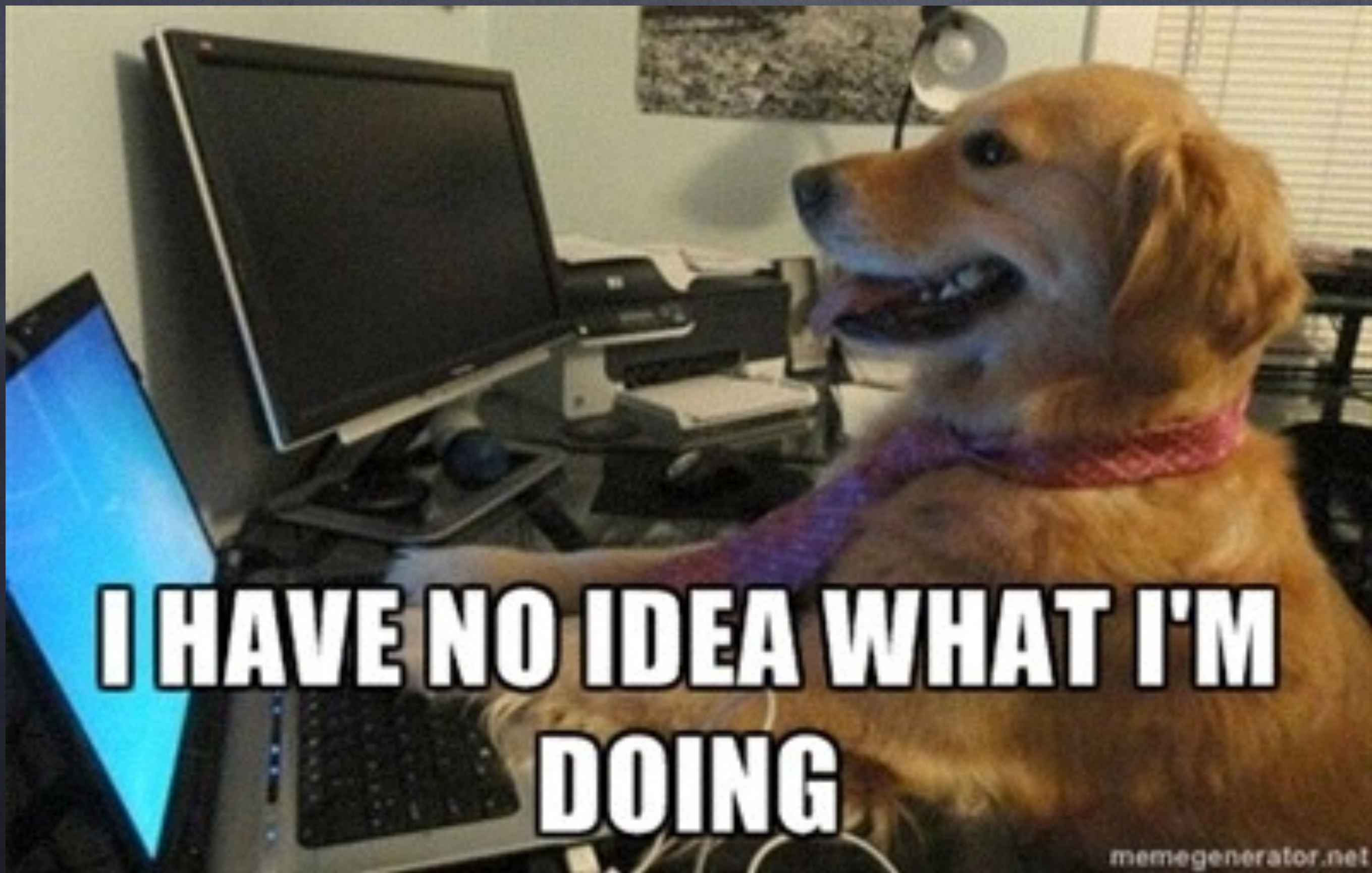
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$$Z_{in} = \frac{V_{in}}{I} = \infty \text{ (AKA very high, which}$$

(I'm told) is why op amps
are so useful)

g-

g-



**I HAVE NO IDEA WHAT I'M
DOING**

Needed: Cellular
computer chip thingy



QUECTEL®
UC15 UC15EA-128-NCH-STD
UC15EQAR01A01M1024

S2-W1467
SN: E163904D5000020
IMEI: 861075020061578

CE2200



UC15 Hardware Design

UMTS/HSDPA Module Series

Rev. UC15_Hardware_Design_V1.3

Date: 2014-04-21



UC15 Hardware Design

UMTS/HSDPA Module Series

Rev. UC15_Hardware_Design_V1.3

Date: 2014-04-21



The following figure shows the reference design of the 8-pin USIM card.

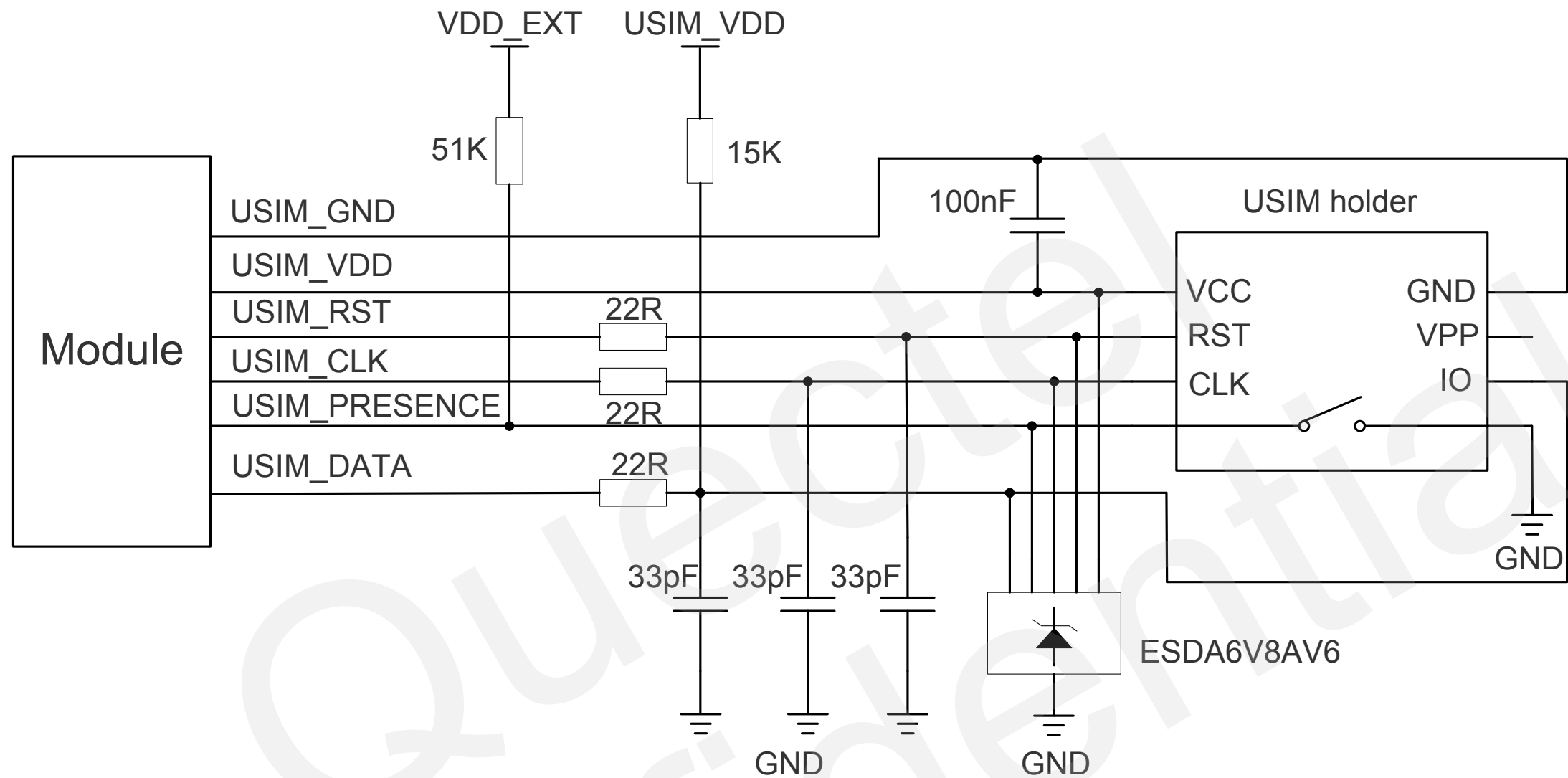


Figure 30: Reference Circuit of the 8-Pin USIM Card

Rubra Penta-band SMD Antenna

Part No. A10393

gigaNOVA®

Product Specification

1 Features

- GSM/UMTS antenna supporting up to 5 frequency bands
- Patented MDA antenna technology provides resistance to de-tuning
- High efficiency
- Easy to integrate
- Intended for SMD mounting
- Supplied in tape on reel

Rubra supports the following communication standards:

GSM/GPRS/EDGE	CDMA2000 1XRTT/EV-DQ/EV-DV	UMTS WCDMA/HSPA	Other Standards
GSM850 (E)GSM900 GSM1800 (DCS) GSM1900 (PCS)	Band Classes: 1,2,3,4,6,8,9,12,14,15	Bands I – VI Bands VIII – X	Korean PCS DECT TD-SCDMA AWS

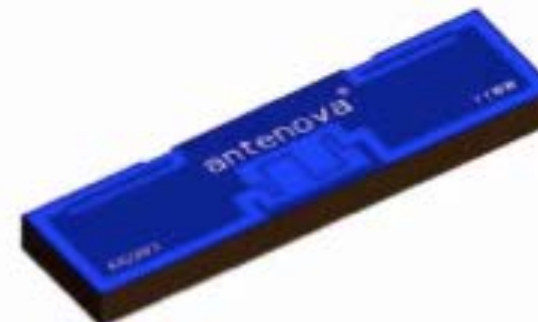
2 Description

Rubra uses a ground plane in order to radiate efficiently, but this ground plane must not extend underneath the antenna itself.

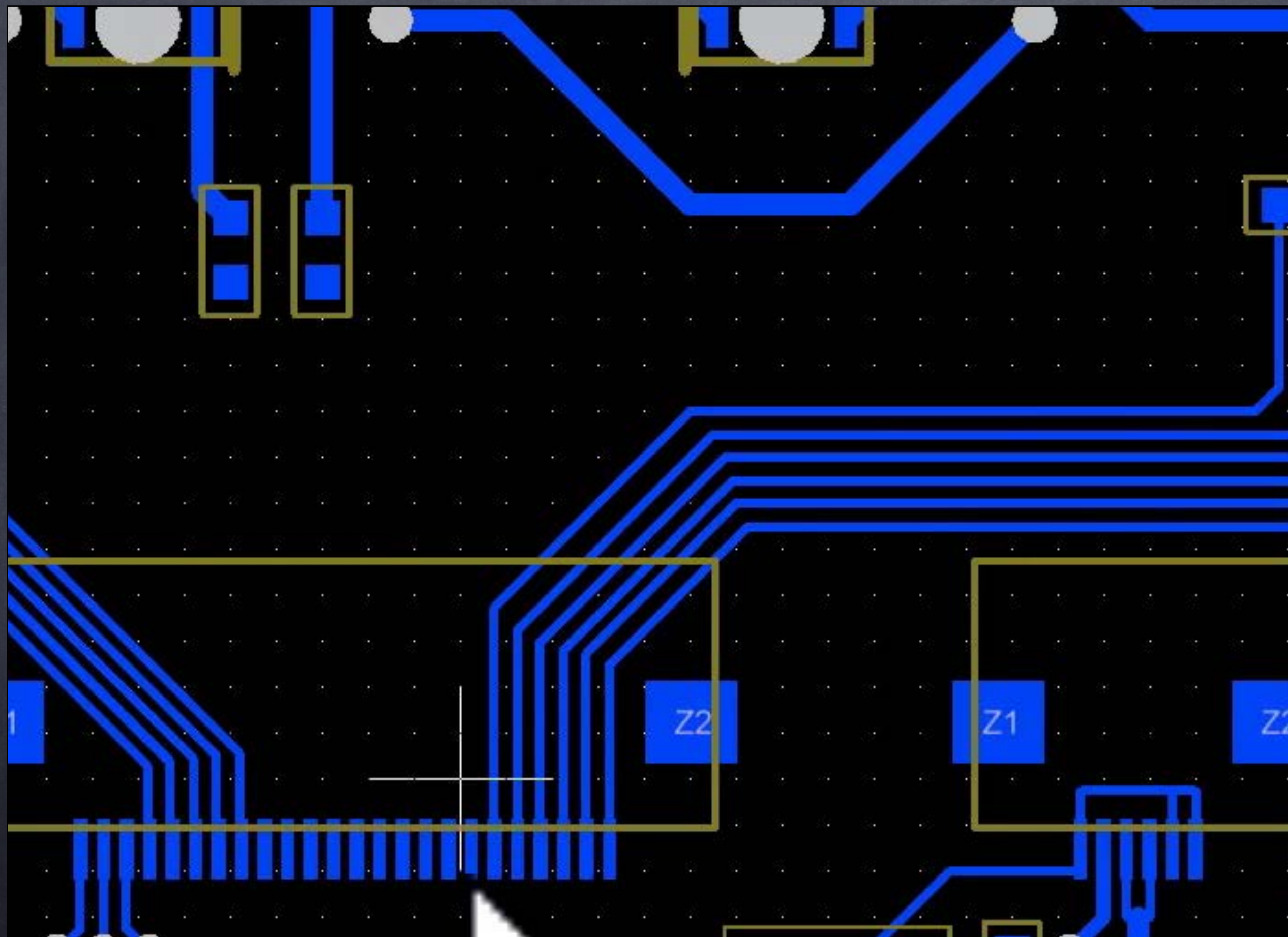
The antenna uses a matching circuit to achieve optimized results for the specific frequency bands that are required. This product specification shows the performance of the antenna when optimized to cover a typical penta-band reception: GSM850/900/1800/1900 and WCDMA.

3 Applications





- Mobile handsets
- Femto / Pico base stations
- Tracker devices
- Machine to machine communication
- Remote monitoring







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-  INSURANCE INCLUDED*
-  PICKUP AVAILABLE

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LABEL MAY BE REQUIRED.

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Shaded from ZIP 97034
Priority Mail
The Best Choice



POSTNET

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KEVIN L
#205
1435 E
PORTLAND

USPS TRACKING




PS00001000014

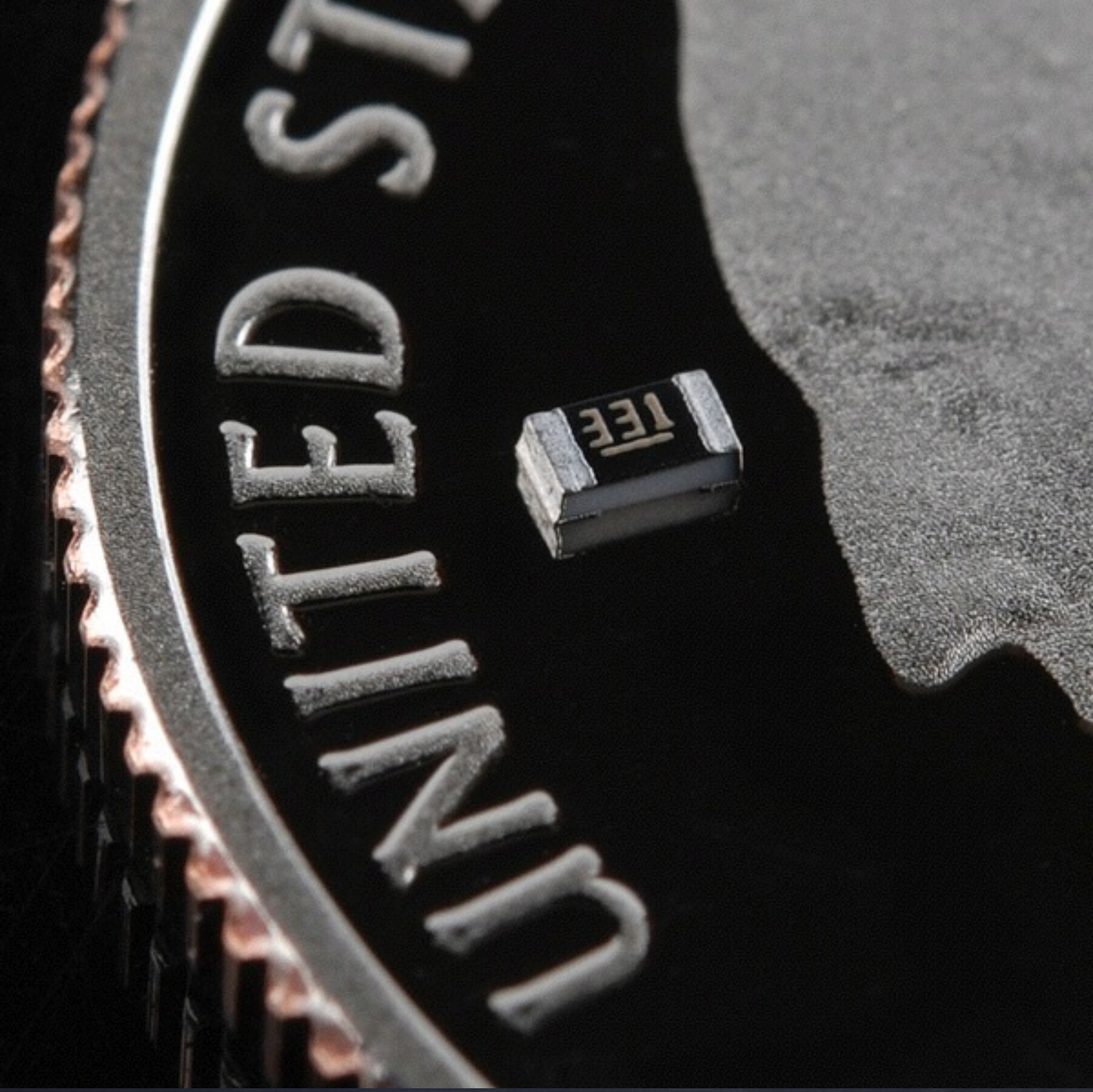
EP1
00: 12.3 X 9.5

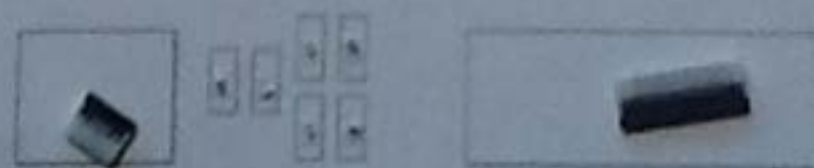
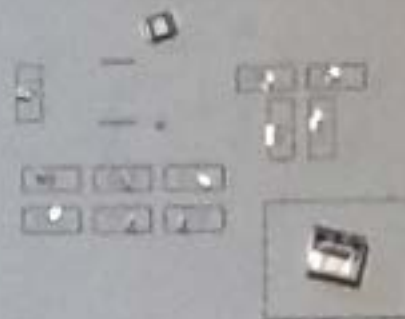
9405 5102 0082 9602 9998 00

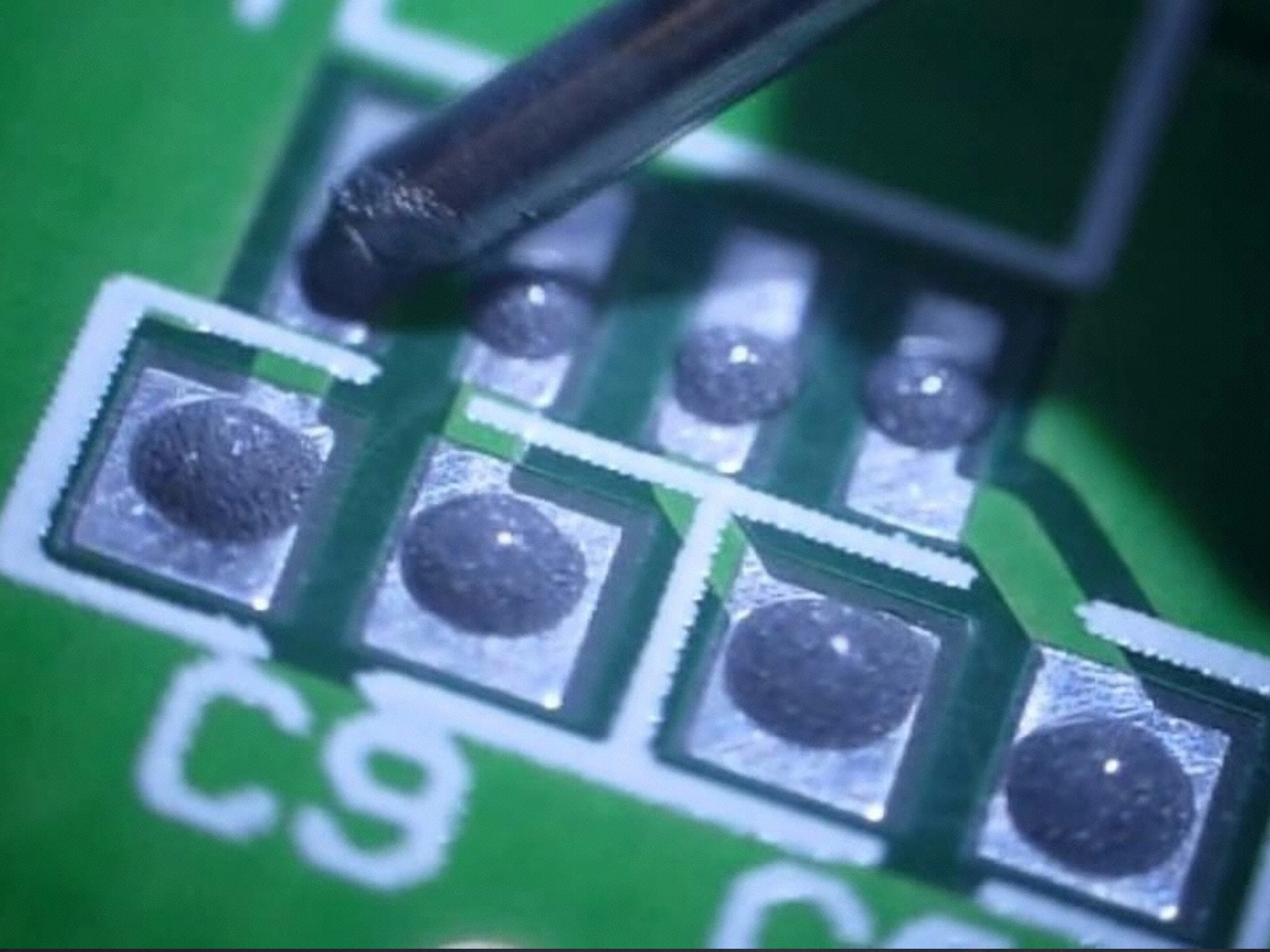
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POSTAL SERVICE

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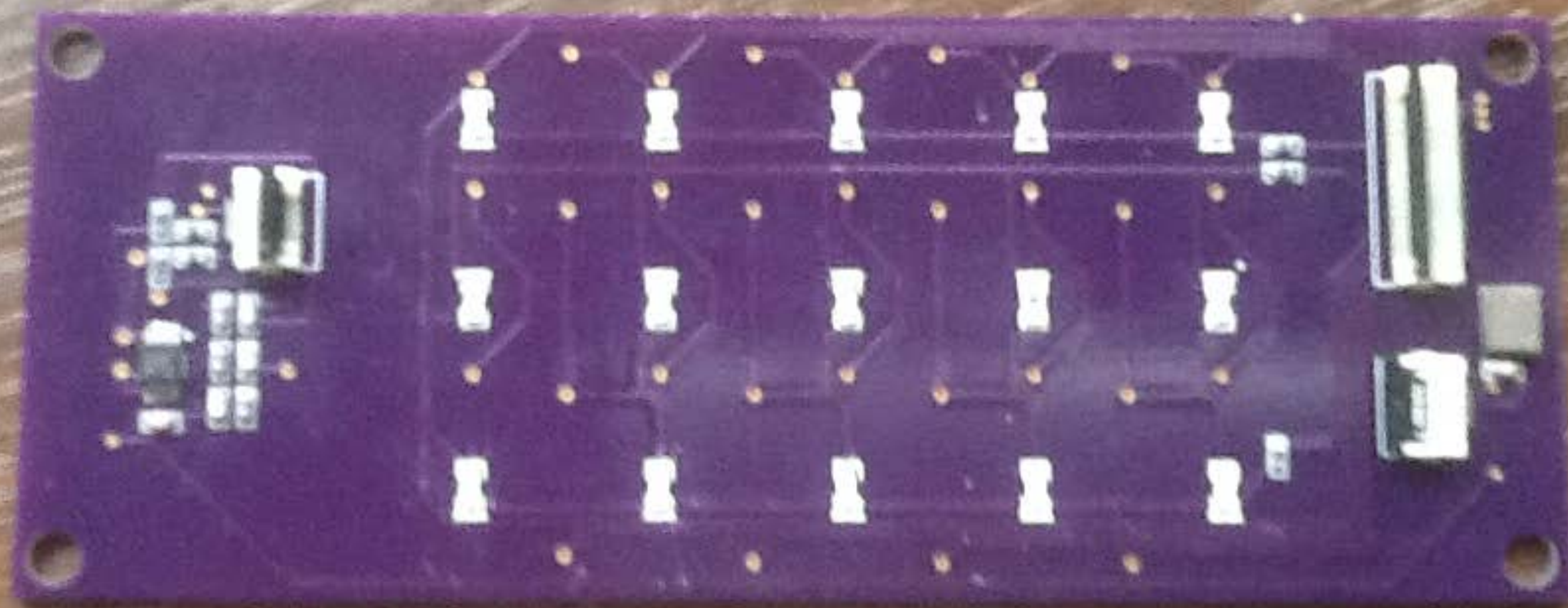












software
stuff

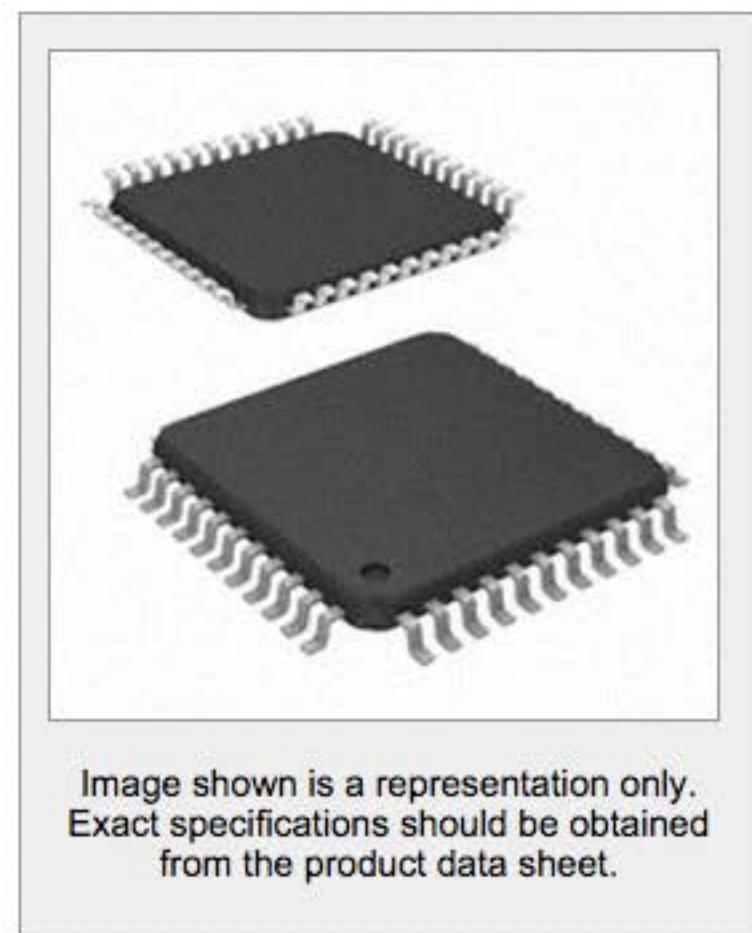
Tiny computer, big responsibilities

- + detect buttons presses
- + blink the lights
- + ask the cellular chip 4 calls
- + detect low batteries, cellular connectivity, &c.

[Product Index](#) > [Integrated Circuits \(ICs\)](#) > [Embedded - Microcontrollers](#) > Atmel ATMEGA1284-AUR

		All prices are in US dollars.		
Digi-Key Part Number	ATMEGA1284-AURCT-ND	Price Break	Unit Price	Extended Price
Quantity Available	Digi-Key Stock: 2,042 Can ship immediately	1	8.03000	8.03
Manufacturer	Atmel	10	7.22400	72.24
Manufacturer Part Number	ATMEGA1284-AUR	25	6.57040	164.26
Description	IC MCU 8BIT 128KB FLASH 44TQFP	100	5.94770	594.77
		250	5.44952	1,362.38
		500	4.98240	2,491.20
Lead Free Status / RoHS Status	Lead free / RoHS Compliant	1,000	4.32846	4,328.46

This part can be programmed by Digi-Key; for details please contact our custom department at 1-800-344-4539 x5725 or custom.orders@digikikey.com



Quantity	Item Number ?	Customer Reference	
<input type="text" value="1"/>	<input type="text" value="ATMEGA1284-AURCT-ND"/> ⬆️⬆️	<input type="text"/>	<input type="button" value="Add to Cart"/>

When requested quantity exceeds displayed pricing table quantities, a lesser unit price may appear on your order. You may submit a [request for quotation](#) on quantities which are greater than those displayed in the pricing table.

Datasheets	ATMEGA164,324,644,1284(A,P,PA) Datasheet ATMEGA164,324,644,1284(A,PA,P) Summary
Product Photos	44-TQFP
Product Training Modules	MCU Product Line Introduction megaAVR Introduction Software Framework (ASF) Example of Use



Alternate Package | This part is also available in the following packaging:

Digi-Key Part Number	Manufacturer Part Number	Manufacturer	Packaging
ATMEGA1284-AURTR-ND	ATMEGA1284-AUR	Atmel	Tape & Reel (TR) ?
ATMEGA1284-AU-ND	ATMEGA1284-AU	Atmel	Tray ?

[Product Index](#) > [Integrated Circuits \(ICs\)](#) > [Embedded - Microcontrollers](#) > Atmel ATMEGA1284-AUR

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Image shown is a representation only.
Exact specifications should be obtained
from the product data sheet.

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Quantity	Item Number 	Customer Reference
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		<input type="button" value="Add to Cart"/>

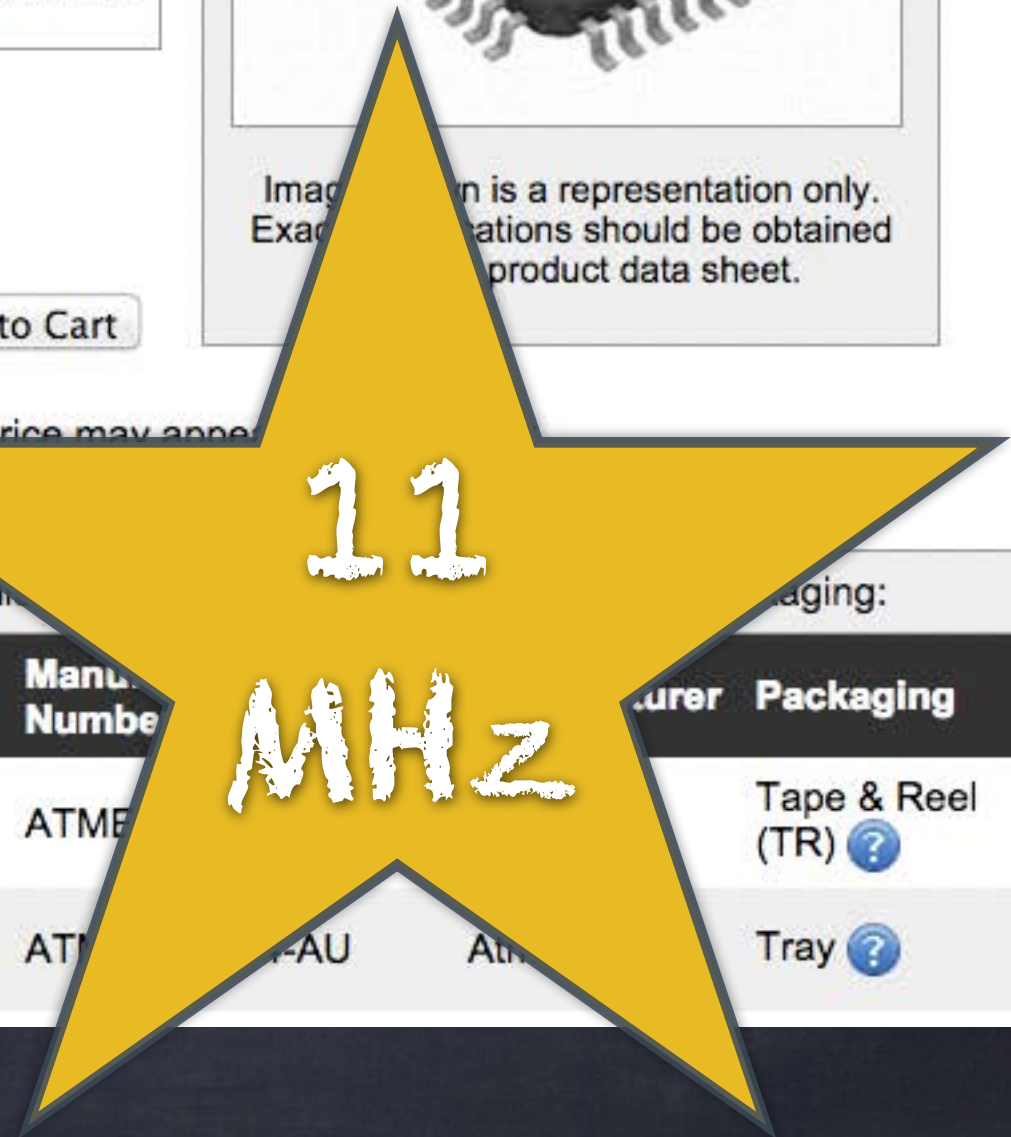
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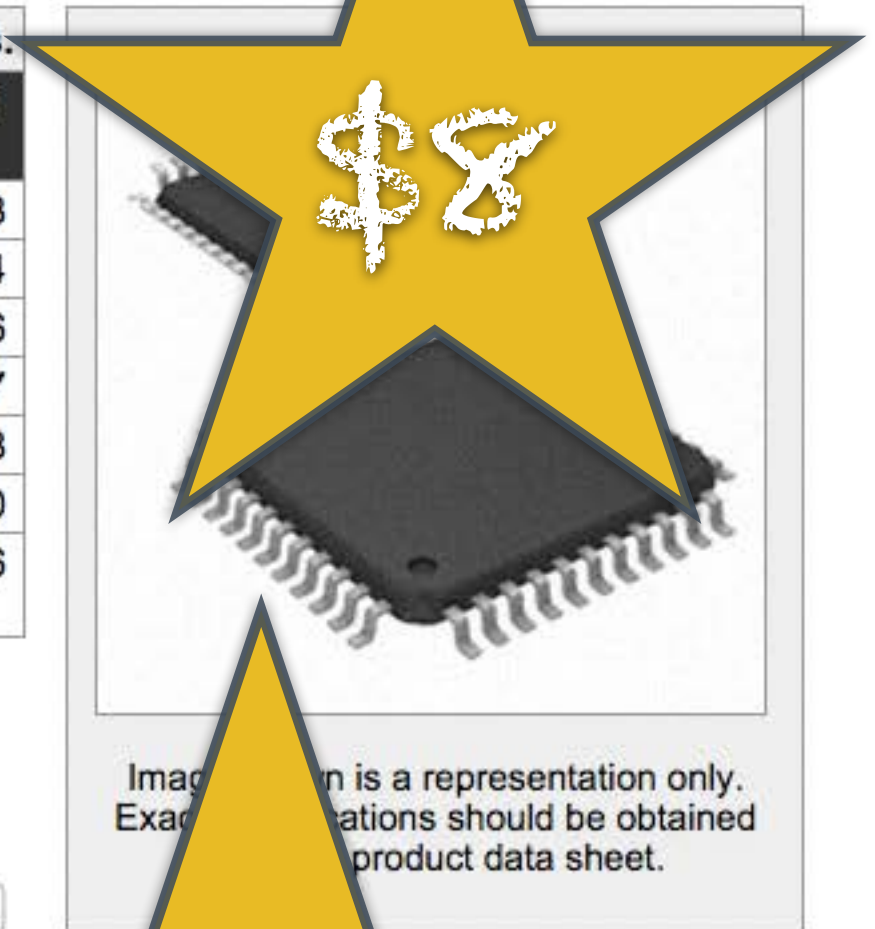
Alternate Package The		Packaging:	
Digi-Key Part Number	Manufacturer Part Number	Manufacturer	Packaging
ATMEGA1284-AURTR-ND	ATME		Tape & Reel (TR) 
ATMEGA1284-AU-ND	ATM	-AU	Tray 



Image is a representation only.
Exact dimensions should be obtained
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Lead Free Status / RoHS Status	Lead Free / RoHS	250	5.44952	1,362.38
		500	4.98240	2,491.20
		1,000	4.32846	4,328.46



128KB program space!

Quantity: 1 [Contact our custom](#) [key.com](#)
Customer Reference
When requested in table quantities, a lesser unit price may apply.
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Datasheet	ATMEGA164,324,644,1284 (P,PA) Sheet ATMEGA164,324,644,1284 (P) Summary
Product Photos	44-TQFP
Product Training Modules	MCU Product Line Introduction megaAVR Introduction Software Framework (ASF) Example of Use

Alternate Package The		Packaging:	
Digi-Key Part Number	Manufacturer Part Number	Manufacturer	Packaging
ATMEGA1284-AURTR-ND	ATME		Tape & Reel (TR) ?
ATMEGA1284-AU-ND	ATME		Tray ?

11 MHz

All prices are in US dollars.

Digi-Key Part Number	ATMEGA1284-AURCT-ND	Price Break	Unit Price	Extended Price
Quantity Available	Digi-Key Stock: 42 Can ship today	1	8.03000	8.03
Manufacturer	Atmel	10	7.22400	72.24
Manufacturer Part Number	ATMEGA1284-AUR	25	6.57040	164.26
Description	128Kbit, 11MHz, 40-Pin QFP	100	5.94770	594.77
Lead-Free Status	RoHS Compliant	250	5.44952	1,362.38
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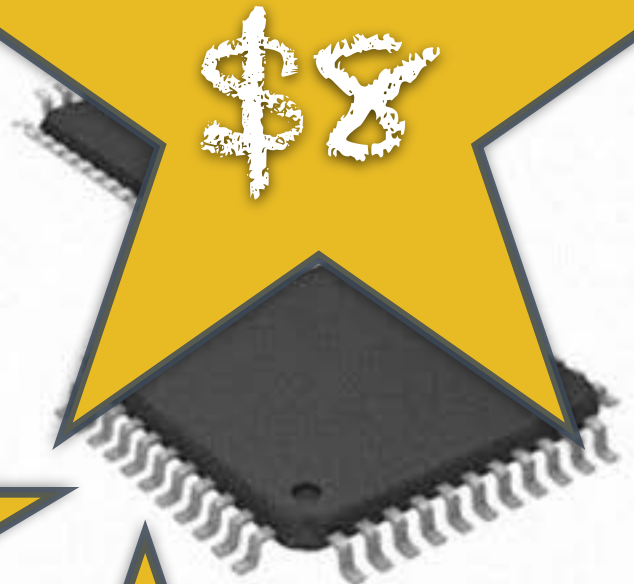


Image is a representation only. Exact dimensions should be obtained from the product data sheet.

Add to Cart

Quantity

1

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Datasheet

Package | Thermal

Shipping:

Product Training Modules

[MCU Product Line Introduction](#)
[megaAVR Introduction](#)
[Software Framework \(ASF\)](#)
[Example of Use](#)

[ATMEGA1284-AURTR](#)

Manufacturer Part Number

ATMEGA1284-AUR

[ATMEGA1284-AURND](#)

ATMEGA1284-AUR

11

MHz

Tape & Reel (TR) ?

Tray ?

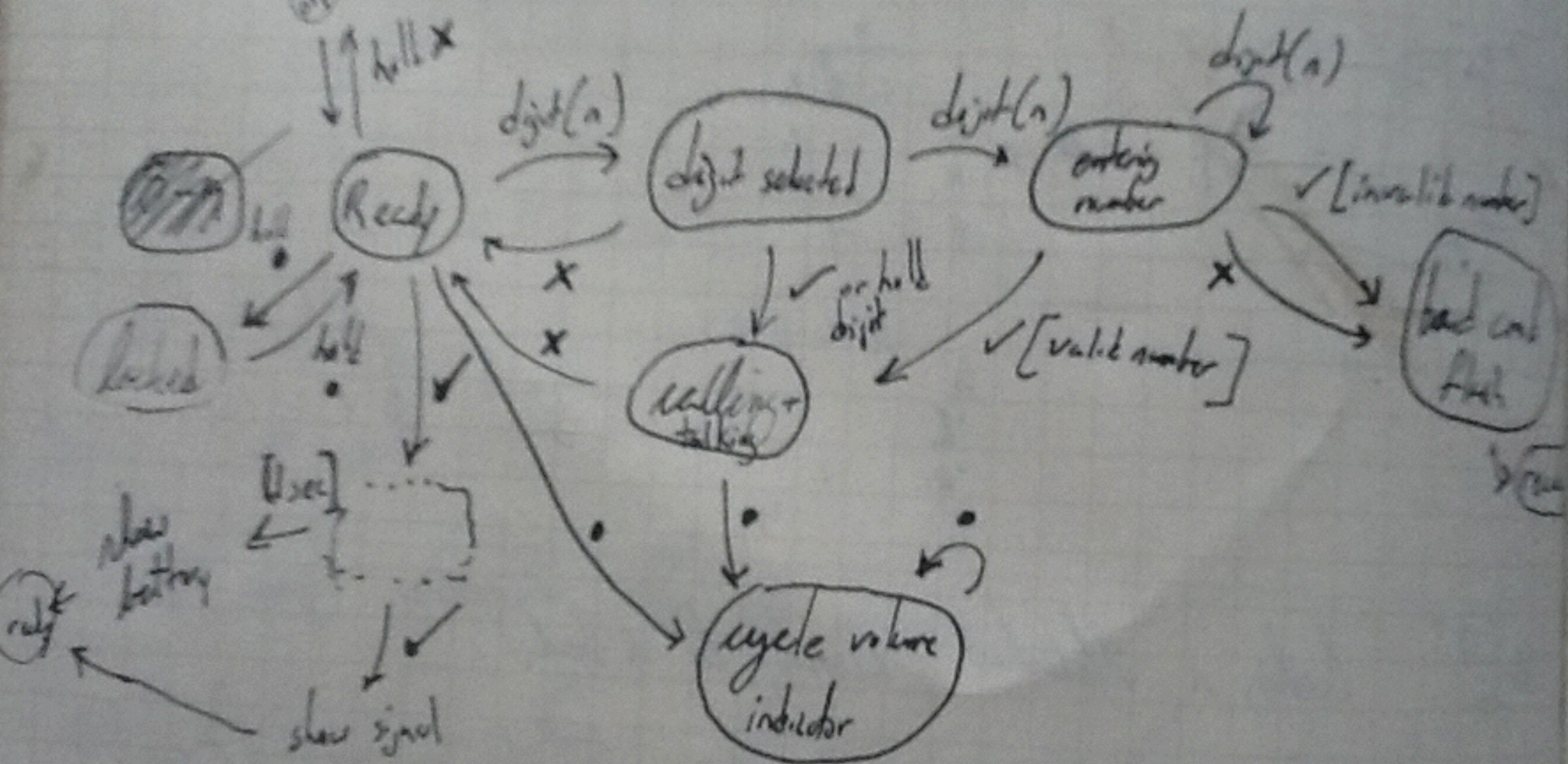
1.4

jQuerys!

No Operating System

- + no threads
- + no garbage collection
- + no sleep();
- + no callbacks

battery (quick poll) .





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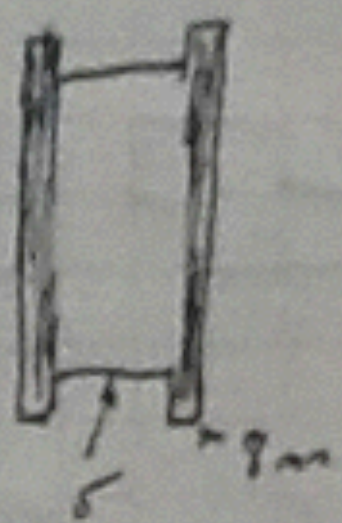
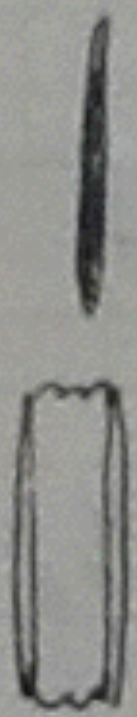
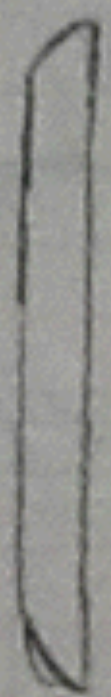
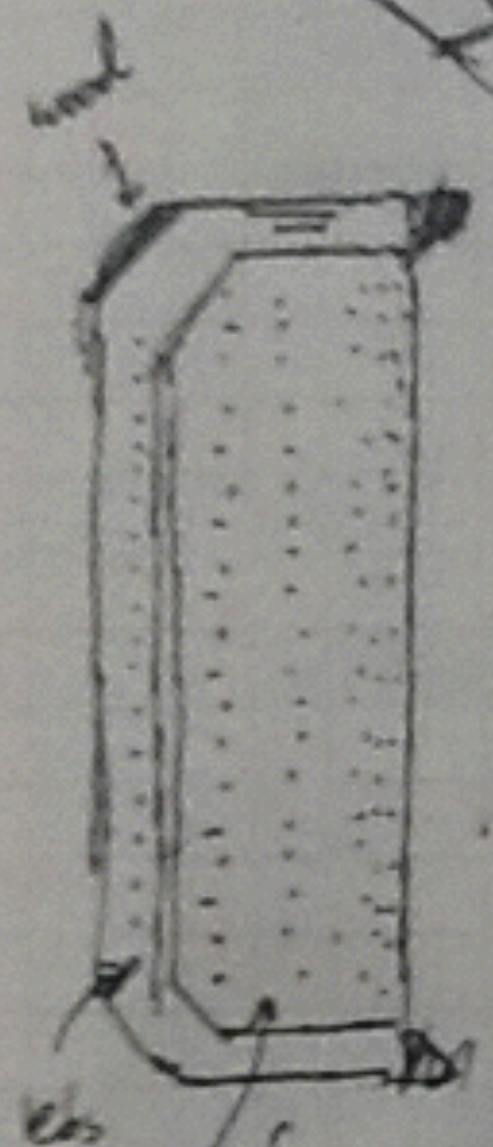
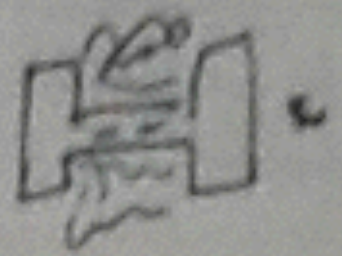
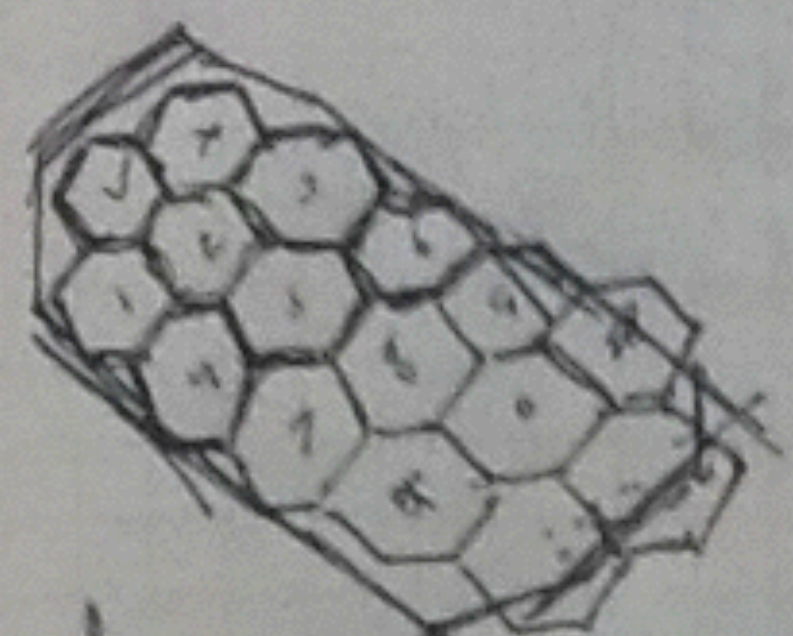
Miro Samek

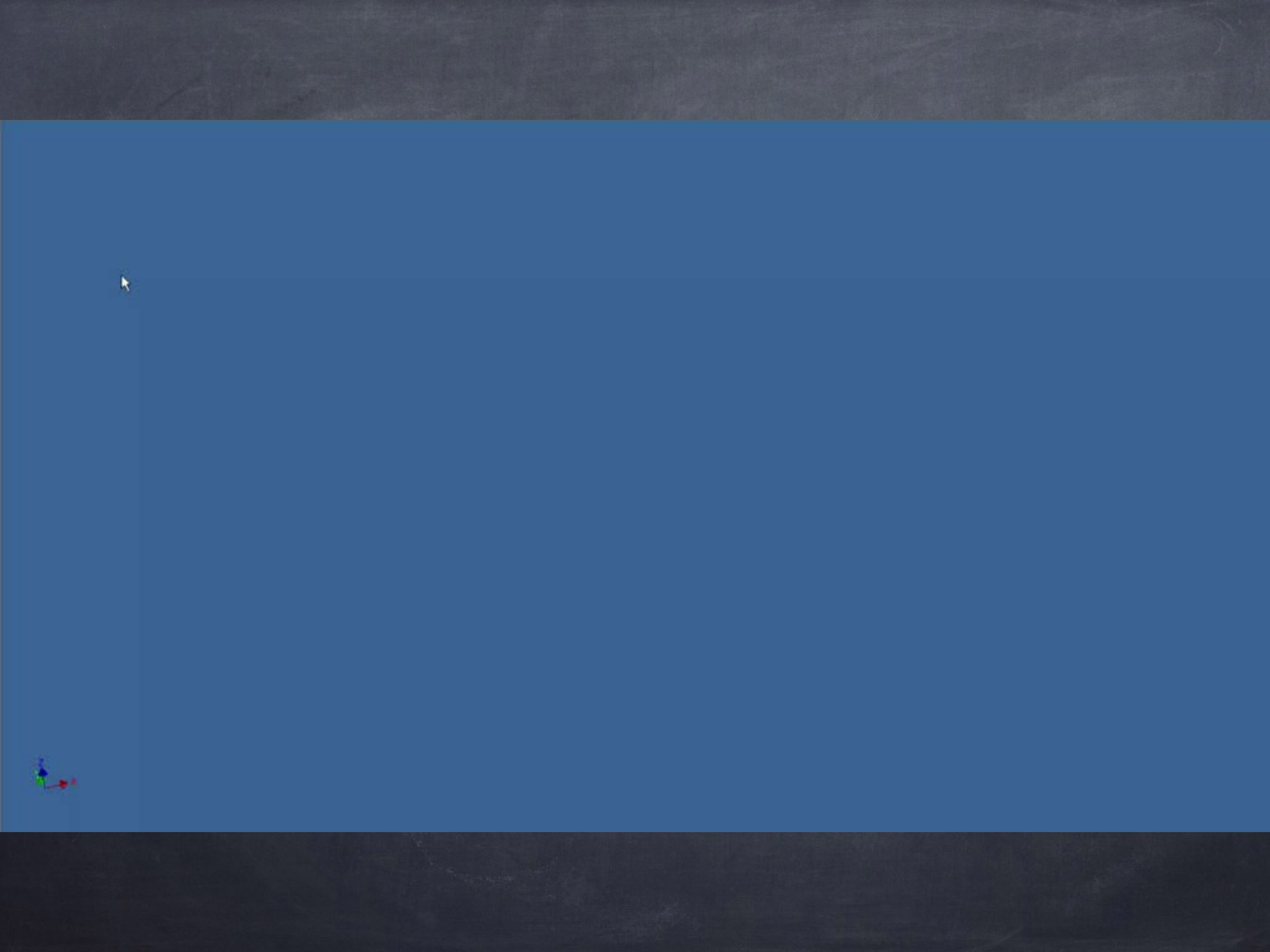
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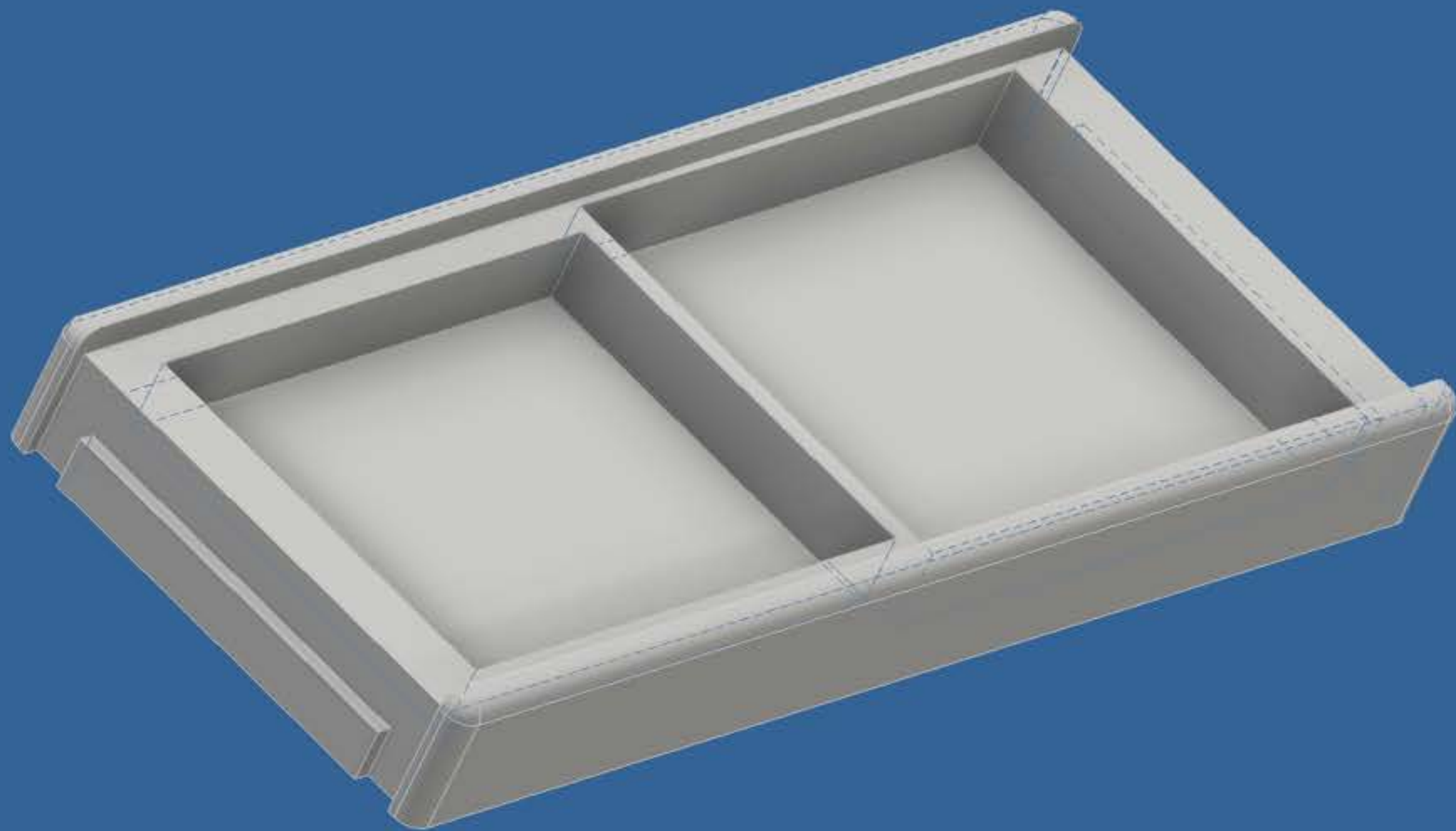


Industrial
design
stuff

for 17 place butter





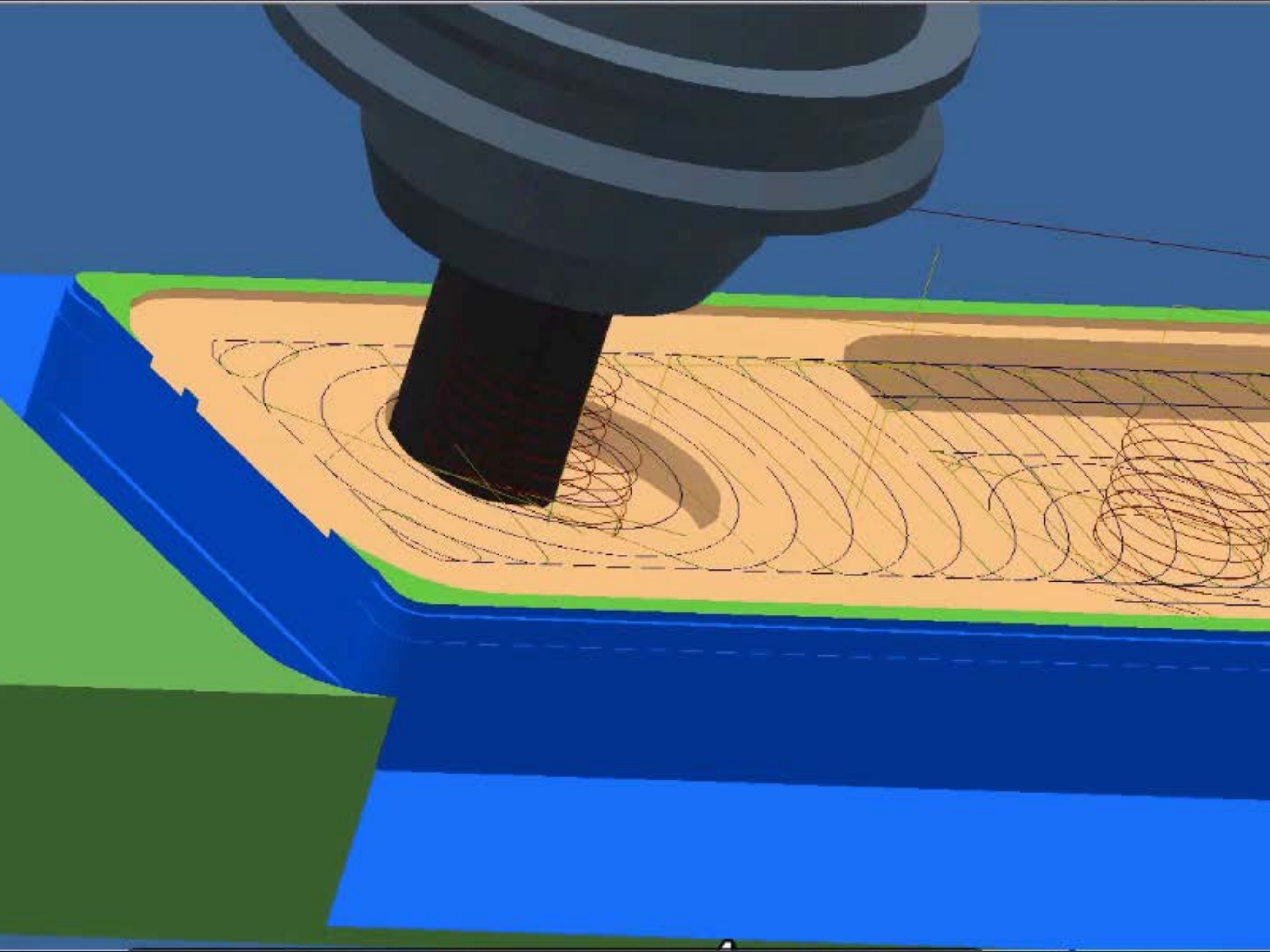


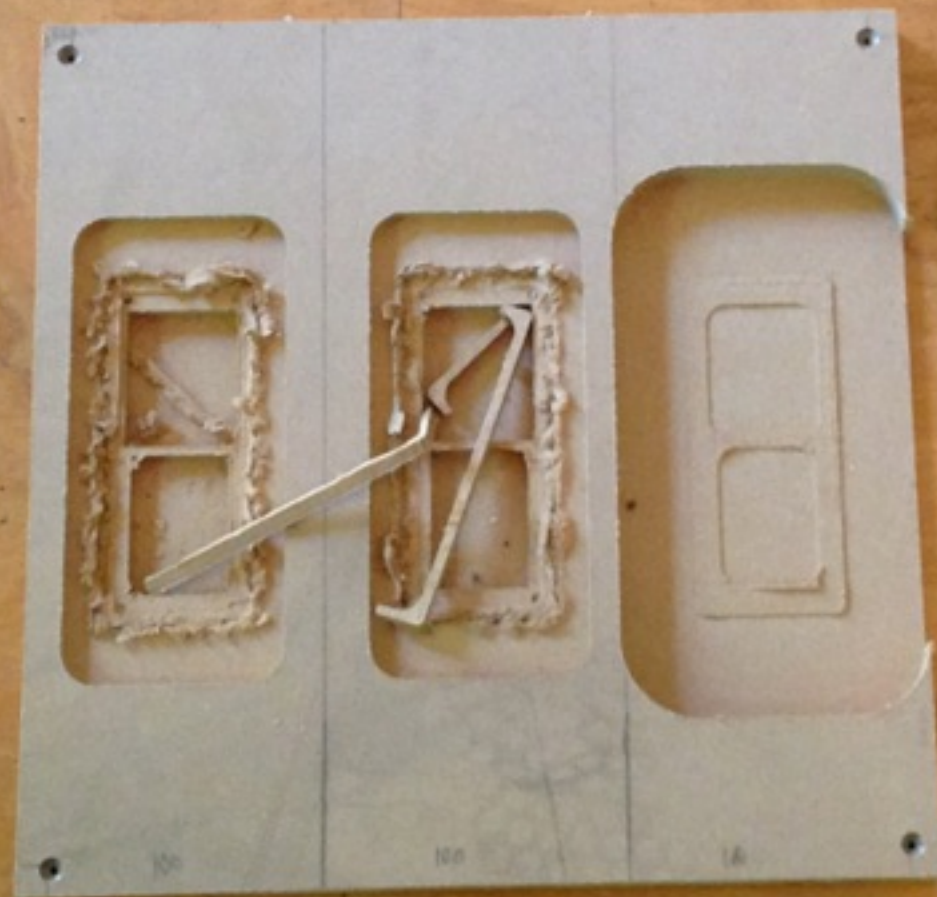




ShopBot

Desktop













I'm 350 hours in.

- + 80h research / sketching / thinking
- + 70h software
- + 70h electrical engineering
- + 30h design / manufacturing
- + 30h workin' with my hands

Making stuff
is hard.

celebrate
your
victories!!

Thanks!

@Lynaghk

(secret mailing list)



keminglabs.com/phone/